

What is claimed is:

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1 1. A reinforced composite ionic conductive polymer membrane

2 comprising:

3 a porous support;

4 an ion-exchange polymer that impregnates the porous support; and

5 a reinforcing agent that impregnates the porous support, the reinforcing agent

6 being at least one selected from the group consisting of a moisture retentive material

7 and a catalyst for facilitating oxidation of hydrogen.

1 2. The reinforced composite ionic conductive polymer membrane as

2 claimed in claim 1, wherein the moisture retentive material comprises at least one

3 selected from the group consisting of SiO_2 , TiO_2 , ZrO_2 , mordenite, tin oxide, and

4 zeolite.

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1 3. The reinforced composite ionic conductive polymer membrane as

2 claimed in claim 1, wherein the catalyst comprises at least one selected from the

3 group consisting platinum (Pt), palladium (Pd), ruthenium (Ru) rhodium (Rh), iridium

4 (Ir), gold (Au), and a Pt/Ru alloy.

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1 4. The reinforced composite ionic conductive polymer membrane as
2 claimed in claim 1, wherein the reinforcing agent comprises about 3-90% by weight
3 of the moisture retentive material and about 10-97% by weight of the catalyst, based
4 on the total weight of the reinforcing agent.

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1 5. The reinforced composite ionic conductive polymer membrane as
2 claimed in claim 1, wherein the ion-exchange polymer includes at least one selected
3 from the group consisting of a sulfonic acid group, a carboxyl group, a phosphoric
4 acid group and a perchloric acid group as a reactive site and has an equivalent
5 weight of about 600-1200 g/H⁺.

1 6. The reinforced composite ionic conductive polymer membrane as
2 claimed in claim 1, wherein the porous support comprises at least one polymer
3 membrane that has at least about 30% porosity.

1 7. The reinforced composite ionic conductive polymer membrane as
2 claimed in claim 1, wherein the porous support comprises at least one polymer
3 membrane that is selected from the group consisting of polytetrafluoroethylene,
4 vinylidene fluoride-hexafluoropropylene copolymer, polypropylene, polyethylene, and
5 polysulfone.

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1 8. The reinforced composite ionic conductive polymer membrane as
2 claimed in claim 1, wherein at least one functional group selected from the group
3 consisting of a carboxyl group, a sulfonic acid group, a phosphoric acid group, and a
4 perchloric acid group is incorporated into the polymer membrane.

1 9. The reinforced composite ionic conductive polymer membrane as

2 claimed in claim 1 which is formed by impregnating or spray-coating the porous
3 support with a composition of the ion-exchange polymer and the reinforcing agent.

1 10. A fuel cell comprising a reinforced composite ionic conductive polymer
2 membrane, the membrane comprising:

3 a porous support;

4 an ion-exchange polymer that impregnates the porous support; and

5 a reinforcing agent that impregnates the porous support, the reinforcing agent

6 being at least one selected from the group consisting of a moisture retentive material
7 and a catalyst for facilitating oxidation of hydrogen.

1 11. The fuel cell as claimed in claim 10, wherein the moisture retentive

2 material comprises at least one selected from the group consisting of SiO_2 , TiO_2 ,
3 ZrO_2 , mordenite, tin oxide, and zeolite.

1 12. The fuel cell as claimed in claim 10, wherein the catalyst comprises at
2 least one selected from the group consisting platinum (Pt), palladium (Pd), ruthenium
3 (Ru) rhodium (Rh), iridium (Ir), gold (Au), and a Pt/Ru alloy.

1 13. The fuel cell as claimed in claim 10, wherein the reinforcing agent
2 comprises about 3-90% by weight of the moisture retentive material and about
3 10-97% by weight of the catalyst, based on the total weight of the reinforcing agent.

1 14. The fuel cell as claimed in claim 10, wherein the ion-exchange polymer
2 includes at least one selected from the group consisting of a sulfonic acid group, a
3 carboxyl group, a phosphoric acid group, and a perchloric acid group as a reactive
4 site and has an equivalent weight of about 600-1200 g/H⁺.

1 15. The fuel cell as claimed in claim 10, wherein the porous support
2 comprises at least one polymer membrane that has at least about 30% porosity.

1 16. The fuel cell as claimed in claim 10, wherein the porous support
2 comprises at least one polymer membrane selected from the group consisting of
3 polytetrafluoroethylene, vinylidene fluoride-hexafluoropropylene copolymer,
4 polypropylene, polyethylene, and polysulfone.

1 17. The fuel cell as claimed in claim 10, wherein at least one functional
2 group selected from the group consisting of a carboxyl group, a sulfonic acid group,
3 a phosphoric acid group, and a perchloric acid group is incorporated into the polymer
4 membrane.

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1 18. The fuel cell as claimed in claim 10, wherein the reinforced composite

2 ionic conductive polymer membrane is formed by impregnating or spray-coating the

3 porous support with a composition of the ion-exchange polymer and the reinforcing

4 agent.

1 19. A direct methanol fuel cell comprising a reinforced composite ionic
2 conductive polymer membrane, the membrane comprising:
3 a porous support;
4 an ion-exchange polymer that impregnates the porous support; and
5 a reinforcing agent that impregnates the porous support, the reinforcing agent
6 being at least one selected from the group consisting of a moisture retentive material
7 and a catalyst for facilitating oxidation of hydrogen.

1 20. The direct methanol fuel cell as claimed in claim 19, wherein the
2 porous support comprises at least one polymer membrane that has a porosity of at
3 least about 30% and a proton exchange functional group.

1 21. The direct methanol fuel cell as claimed in claim 19, wherein the
2 porous support comprises at least one polymer membrane selected from the group
3 consisting of polytetrafluoroethylene, vinylidene fluoride-hexafluoropropylene
4 copolymer, polypropylene, polyethylene, and polysulfone.

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1 22. The direct methanol fuel cell as claimed in claim 20, wherein the proton
2 exchange functional group is at least one selected from the group consisting of a
3 carboxyl group, a sulfonic acid group, a phosphoric acid group, and a perchloric acid
4 group.

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1 23. A method of forming a reinforced composite ionic conductive polymer
2 membrane, the method comprising the steps of:
3 providing a porous support;
4 forming a mixture of an ion-exchange polymer and a reinforcing agent, the
5 reinforcing agent being at least one selected from the group consisting of a moisture
6 retentive material and a catalyst for facilitating oxidation of hydrogen, and
7 impregnating the porous support with the mixture.